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REFUSE HANDLING SYSTEM

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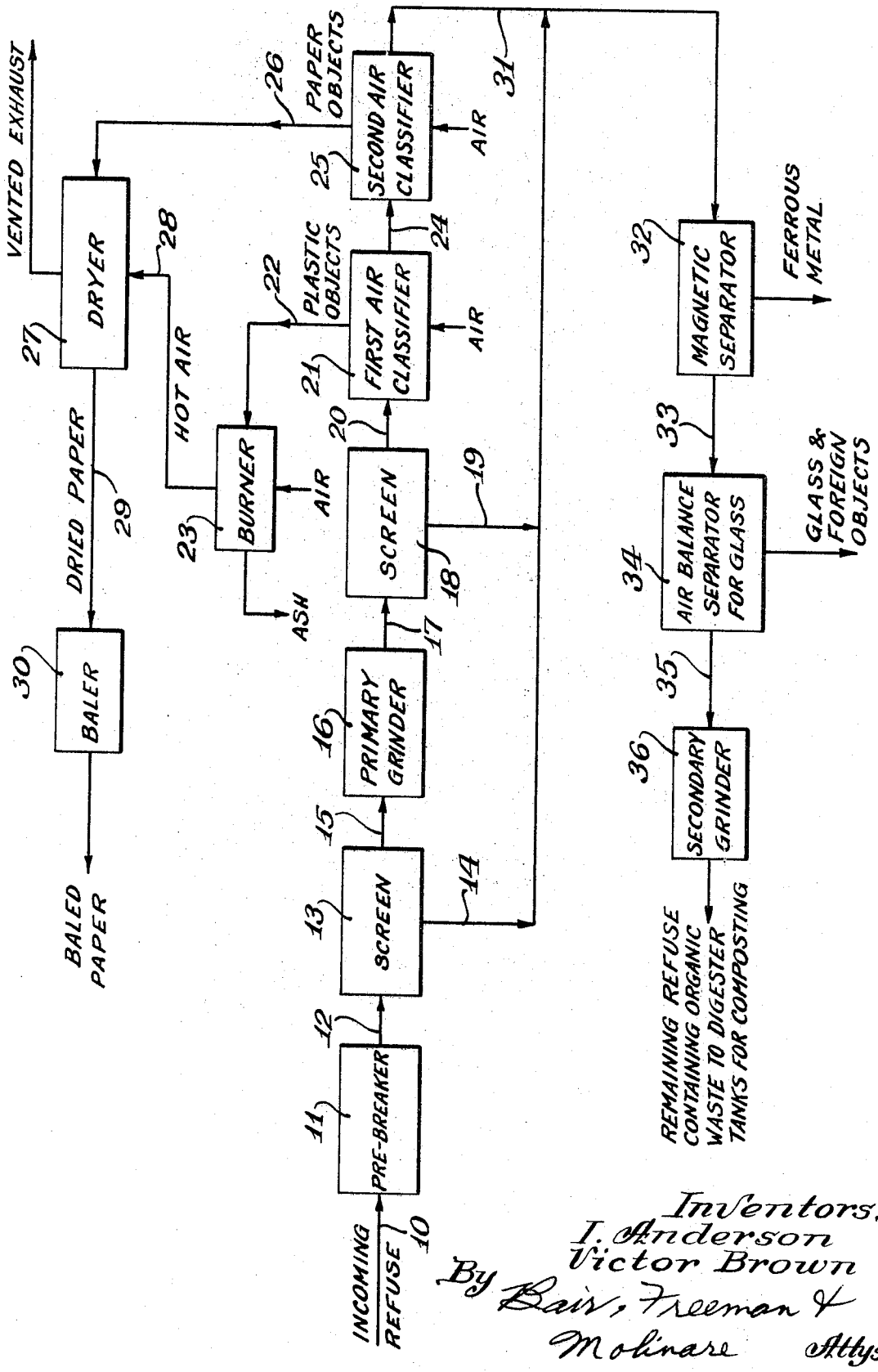


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# REFUSE HANDLING SYSTEM

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## ABSTRACT OF THE DISCLOSURE

An improved process for mechanically separating municipal refuse into useful portions without manual sorting, comprising prebreaking of the largest objects in the refuse, screening and by-passing the fines in the refuse, grinding of the refuse to a suitable size, removing plastic objects from the refuse by a first air classifier, removing paper objects from the refuse by a second air classifier, separating ferrous metal and glass objects by a magnetic separator and an air balance separator, the remaining refuse containing the organic waste may be further processed, such as by composting. The removed plastic objects may be burned to produce heat for drying the removed paper objects so that the latter may be packaged and sold.

This invention is an improved process over that disclosed in co-pending application Ser. No. 529,126, filed Feb. 21, 1966, for "Composting Process," in the name of Victor Brown.

## BACKGROUND OF THE INVENTION

This invention relates to an improved process for mechanically handling and separating municipal refuse into useful or processable portions. More particularly, the invention relates to an improved process for mechanically handling and separating municipal refuse without the need for manual sorting therefor.

In an article entitled "Composting Plant Converts Refuse Into Organic Soil Conditioner," printed in the Nov. 6, 1967 issue of Chemical Engineering, there is shown a composting process developed by the Metropolitan Waste Conversion Corporation, the applicants' employer. In said process, municipal refuse is first manually sorted to remove paper, glass, metal and other noncompostible objects. The refuse is then comminuted and the shredded paper and plastics are removed from the refuse by suction, and the tin cans are removed by magnetic separation. The comminuted refuse is then mixed with thickened sludge from the municipal sewer and the mixture digested in digesting tanks. The digested mixture is then ground and dried before use as a soil conditioner. The shredded light paper and plastic materials removed from the refuse are burned to supply heat in the final drying process.

The shredding, removing and burning of the paper and like objects in municipal refuse for the purpose of supplying energy in the further processing of the refuse was first disclosed in said application Ser. No. 529,126.

In processes of the prior art for treating municipal refuse, some manual sorting of the incoming refuse is required. Such a manual sorting of the incoming refuse substantially increases the processing cost. Moreover, it is becoming increasingly difficult to find laborers who are willing to do this type of work. This is apparently due to the availability of other high-paying jobs and the relatively low status of garbage sorting positions. Thus, it has become extremely desirable to develop a municipal refuse handling system wherein the refuse may be separated into useful or processable portions entirely by

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mechanical means, without the need of a manual sorting operation.

It is accordingly a principal object of the present invention to provide a process for separating municipal refuse into useful and/or processable fractions entirely by mechanical means.

It is another object of the present invention to provide a process for separating municipal refuse wherein manual sorting and picking is rendered unnecessary.

It is a further object of the present invention to provide an improved refuse handling system which is economically attractive.

Still other objects of the invention can be gathered by one skilled in the art from a reading of the disclosure herein.

## SUMMARY OF THE INVENTION

In accordancec with the above objects, the present invention provides a process for mechanically separating municipal refuse into useful and/or processable fractions by: subjecting the incoming refuse to a pre-breaking operation wherein relatively large objects in the refuse, say, objects having a diameter larger than one to three feet, is broken to prepare the refuse for the primary grinding operation; a preliminary screening of the refuse from the prebreaker to separate the fines which is by-passed to a later stage; passing the larger refuse into a primary grinder to reduce the particle size to about 6 inches square and smaller; again screening the ground refuse to separate fines and to by-pass the same; subjecting the refuse to the action of a first air classifier to remove the plastic objects, such as plastic films or cellophane therein; subjecting the refuse to a second air classifier to remove the paper objects therein; mixing the remaining refuse from the second air classifier with fines previously separated in screening operations and subjecting the mixture to the action of a magnetic separator to remove ferrous metal objects; subjecting the refuse to the action of an air balance separator to remove glass objects; the remaining refuse contains the organic waste and can be further processed by known methods, such as by composting.

It is an important feature of the present invention that the plastic films and other plastic objects are mechanically and separately removed from the paper objects. The plastic objects so removed may be burned to provide heat energy to dry the paper objects. The paper objects in municipal refuse typically may contain moisture which must be driven off before the paper can be resold for further processing. In this manner, the present invention provides a method whereby the heat for drying the paper is supplied by burning the plastic objects in the refuse. After drying, the paper may be baled and sold.

The viability of a refuse handling system depends on many economic factors such as: the amount of manual labor required by the process; the marketability of by-products from the process such as paper, metal, glass objects; and the conversion of the organic waste portion of the refuse into a usable product, etc. The present invention provides a process wherein manual labor is rendered unnecessary whereby the cost of labor in prior art processes is eliminated. Moreover, the present process also eliminates the problem associated with labor shortage for manually sorting municipal refuse. The fact that the present process separates the plastic objects from the paper objects in the refuse permits the drying of the paper, which is a valuable by-product in any refuse handling system. It can be seen from the following descriptions that the process of the invention takes advantage of existing types of heavy-duty equipment which further makes the present process economically attractive.

## DESCRIPTION OF THE DRAWING AND PREFERRED EMBODIMENT

The invention is further illustrated by the drawing which shows a preferred embodiment of the process of the invention. In the drawing, which is a schematic flow diagram, the incoming refuse, generally indicated at **10** is passed through a pre-breaker **11**. The pre-breaker may have a large clearance therein, for example, three feet, to permit large objects to pass therethrough. The purpose of the pre-breaker is only for cutting down the size of extremely large objects. The pre-broken refuse **12** is then fed onto a screen **13** to remove fines **14** which is by-passed around the primary grinder and further processed as described below. Screen **13** may conveniently have 1 inch mesh openings and fines **14** passing therethrough is made up of organic materials, such as leaves and food particles, dust and other broken and small objects. The screened refuse **15** is then conveyed to a primary grinder **16** for shredding. Primary grinder **16** reduces the size of the refuse particles to no larger than about 6 inches square. The shredded refuse **17** is then passed through a screen **18** to remove fines **19**. Screen **18** is similar to screen **13** and also has 1 inch mesh openings. The screened and shredded refuse **20** is conveyed to a first air classifier **21** in which air under pressure lifts the lighter plastic objects in the refuse, such as plastic films and cellophane, and separates the same from the main body of the refuse. The velocity of the air must be at least about 350 ft./min. to entrain the plastic film. It should not exceed about 400 ft./min. since higher velocities will entrain other unwanted materials. Separated plastic objects **22** are conveyed to a burner **23** to be more fully described below. The refuse from the first air classifier **21**, indicated at **24**, is then conveyed to a second air classifier **25**. In air classifier **25**, the paper objects **26** in the refuse are lifted and separated from the main body of the refuse by air and conveyed to a dryer **27** for removal of the moisture which is normally present in paper found in municipal refuse. The velocity of the air must be at least about 450 to 500 ft./min. to entrain the paper. Screen **18** and air classifiers **21** and **25** may conveniently be constructed as compartments of one machine; for example, as a large screen 6 feet by 25 feet and having a bed depth of about 3 feet, with screen **18** being the first compartment at a size 6 feet by 12 feet and air classifiers **21** and **25** dividing the remaining space. It should be noted that all sizes are given by way of an example only, since actually the size of any particular apparatus would depend upon such factors as the volume of refuse to be handled and the nature of the refuse.

Dryer **27** is operated by a stream of hot air **28** from the burner **23**. Thus, the plastic objects in the refuse are burned to provide heat energy for drying the paper which is separately removed from the refuse. The heat from burning the light plastic objects may be insufficient to dry the paper objects, particularly when the paper is very wet as happens on a raining day, and auxiliary heaters may be required to supply additional heat. Such auxiliary heaters may be conveniently of known design and burn any available fuel such as coal, natural gas, oil, etc. Alternatively, a portion of the paper may be burned to supply the additional heat required. The dried paper **29** is then conveyed to a baling apparatus **30** for further disposition.

The remaining refuse **31** emerging from the second air classifier **25** is then combined with fines **14** and **19** and the mixture conveyed to a magnetic separator **32** for the separation of ferrous metal objects from the refuse. The non-ferrous refuse **33** issuing from the magnetic separator is then conveyed to an air balance separator **34** for removal of glass objects. Some foreign materials, such as ceramic objects, are also removed by the air balance separator. The construction of the magnetic separator and the air balance separator is known and they are available commercially. The remaining refuse **35** is then conveyed to a secondary grinder **36** for preparing the refuse particles



to the proper size suitable for further processing such as composting. This remaining refuse contains the organic waste and can be treated, for example, in accordance with the processes disclosed in co-pending applications Ser. No. 529,127 and Ser. No. 588,359.

As indicated above, the purpose of the pre-breaker is to reduce the size of the largest objects in the incoming refuse so that they can be handled by the primary grinder. Depending on the particular primary grinder employed, the pre-breaker may be employed to reduce the size of the refuse particles to not more than, for example, 1–3 feet in diameter. The screening of the refuse is for the purpose of removing fines which may be ground glass, dust, small particles of paper, metal and plastics, etc. If these fines are not separated from the refuse, they may be classified and removed by the air classifiers. The screening operation also removes leaves and grass which are in the refuse.

The screened refuse is then shredded in a primary grinder which reduces particle size to a level suitable for subsequent processing. The shredded refuse typically may have a size about 6 inches square and smaller. The shredded refuse is then again screened before conveying to the first air classifier where the lighter objects, primarily plastic films and cellophane, but which may include small pieces of paper and other lighter materials, are lifted by air under pressure and separated from the main body of refuse. The remaining refuse is then passed into a second air classifier where air under stronger pressure is used to remove all extractible paper objects. The lighter plastic materials removed in the first air classifier is burned to provide heat for drying the removed paper in a dryer, which may be of conventional construction, for example, the tumbler type. Heat in addition to that obtainable from the burning of the plastic objects may be required to dry the removed paper, particularly when the incoming refuse is wet and such additioinal heat may be provided by auxiliary burners or heaters (not shown). The remaining refuse is then mixed up with the fines previously screened out and conveyed to the magnetic separator for ferrous metal removal and air balance separation for glass and foreign object removal.

The first air classifier may be operated at an air pressure of from about 6 to 8 pounds per square inch and the second air classifier may also be operated at 6 to 8 p.s.i. These air pressures may have to be varied and adjusted to suit the nature of the refuse collected. For example, on a raining day, the refuse may be wet and higher air pressure is needed to classify the refuse.

It can be seen from the above that the present process provides a mechanical method for handling municipal refuse substantially automatically and requires a minimum of manual attention. The elimination of manual labor results in a substantial saving thus making the process more economically attractive than the process of the prior art. In addition, the elimination of manual labor also solves the problem of the shortage of labor in this industry.

By separately removing the lighter plastic objects and the heavier paper objects from the refuse, the present process permits the burning of the plastic objects to provide heat for the drying of the paper removed. Since municipal refuse may contain from about two-thirds to three-fourths paper, the removed paper constitutes a substantial portion of the incoming refuse. In this manner, the present process is capable of producing very large quantities of waste paper which is extremely valuable to the paper industry for reprocessing purposes. The sale of the waste paper further makes the present process economically attractive.

The ferrous metal and glass objects which are separated from the refuse are also valuable by-products of the present process. These by-products are also sold to produce revenue and to reduce the cost for operating the refuse handling system.

A further advantage of the present process resides in the fact that a more valuable remaining refuse is obtained. As indicated above, municipal refuse presently may contain three-fourths paper. Such paper content makes the refuse high in cellulose content. The most important use for the organic waste containing refuse being that of a soil conditioner or fertilizer, the cellulose in the refuse is undesirable because it has no nutritional value for the soil. Thus, by removing all extractable paper from the municipal refuse, the present process reduces the cellulose content in the remaining refuse and makes the same more suitable for use as a soil conditioner or fertilizer.

What is claimed is:

1. A process for mechanically separating municipal refuse, containing organic waste, into useful portions comprising: passing said refuse through a pre-breaker to break up large objects in said refuse, grinding the partially broken refuse from said pre-breaker in a primary grinder to reduce the particle size of said refuse to a level suitable for further processing, passing said ground refuse through a first air classifier to remove lightweight plastic objects from said refuse, passing the remaining refuse through a second air classifier to remove paper objects from sair refuse, and passing the remaining refuse through a magnetic separator for ferrous metals and an air balance separator for glass objects to obtain a refuse which contains a high proportion of organic waste for further processing.

2. The process of claim 1 further comprising burning said removed plastic objects to provide heat for drying said removed paper objects, drying said removed paper objects and packaging the dried paper objects for transportation.



3. The process of claim 1 further comprising composting said refuse containing a high proportion of organic waste.

4. The process of claim 1 wherein said refuse from said pre-breaker being passed through a screening operation prior to said primary grinder to remove fines therefrom, by-passing said fines and adding the same to said remaining refuse from said second air classifier for further processing.

5. The process of claim 1 wherein said first air classifier is operating at an air pressure of about 6 to 8 pounds per square inch.

6. The process of claim 1 wherein said second air classifier is operating at an air pressure of about 6 to 8 pounds per square inch.

7. The process of claim 1 wherein said lightweight plastic objects are plastic films.


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JAMES M. MEISTER, Primary Examiner

U.S. Cl. X.R.

241—24, 25, 29, 76, 79.1